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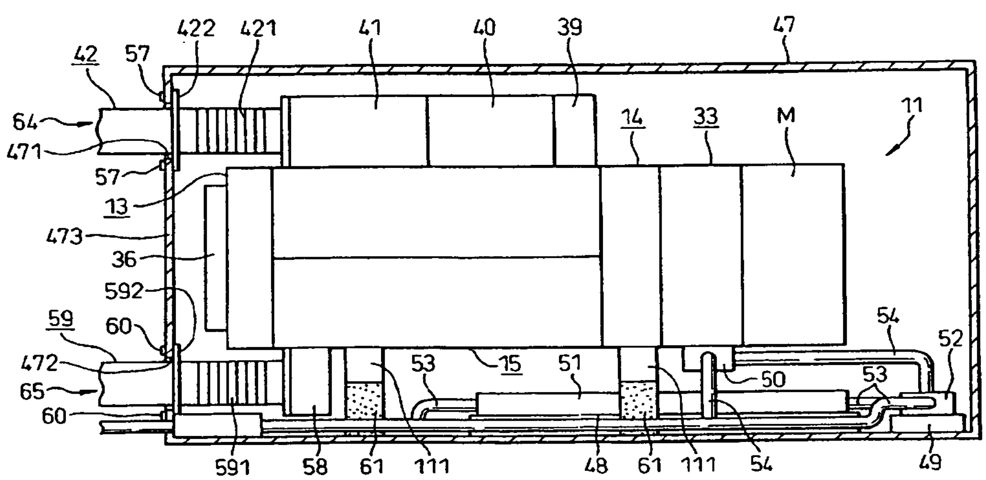
(54) **Vacuum pump**

(57) A main body of a multi-stage Roots pump 11 is incorporated in a cover 47. A connecting flange 39, a muffler 40, a guide pipe 41 and a discharge pipe 42 constitute a discharge piping mechanism 64. The discharge pipe 42 incorporates a bellows 421. A connecting flange 58 and a suction pipe 59 constitute a suction piping mechanism 65. The suction pipe 59 incorporates a bellows 591. The bellows 421, 591 are incorporated in the cover 47.

Thus, loads generated when the bellows constituting part of the gas flow path of a vacuum pump are elastically deformed, by virtue of changes in internal pressures, are prevented from extending to auxiliary equipment.

Fig.1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a flow path structure for a vacuum pump in which a gas delivering body in a pump chamber is activated based on rotation of a rotating shaft so that gas is caused to flow through the operation of the gas delivering body to thereby provide a sucking operation.

2. Description of the Related Art

[0002] Vibrations of the main body of a vacuum pump are transmitted, by suction piping for sucking gas into the main body of the vacuum pump and discharge piping for discharging gas, from the main body of the vacuum pump. The vibrations are then transmitted to auxiliary equipment to which the suction piping or discharging piping is connected, and the auxiliary equipment is vibrated, whereby the level of noise is increased. In order that the vibrations of the main body of the vacuum pump are not transmitted directly to the auxiliary equipment through the suction piping or discharge piping, it is considered as a measure against the problem that a bellows is interposed on the suction piping or the discharge piping. The bellows so interposed on the suction piping or discharge piping absorbs the transmitted vibrations. This suppresses the vibration of the auxiliary equipment, which in turn suppresses the noise level.

[0003] The pressure within the suction piping varies from the atmospheric pressure to a negative pressure which is close to zero. On the discharge piping, in order to suppress discharge pulsation, a check valve is disposed at the discharge piping. In this case, the pressure within the discharge piping from the main body of the vacuum pump to the check valve varies from a positive pressure which is higher than the atmospheric pressure, to a negative pressure which is close to zero. In addition, the pressure within the discharge piping downstream of the check valve varies from a positive pressure, which is higher than the atmospheric pressure, to the atmospheric pressure. An atmospheric atmosphere is present in a pump chamber of the vacuum pump before the vacuum pump starts to operate, and the positive pressure higher than the atmospheric pressure is generated when the atmospheric atmosphere is compressed immediately after the vacuum pump starts to operate. In a case where a bellows is used as part of the suction piping or discharge piping whose pressure varies as has been just described, the bellows is elastically deformed to extend or contract by virtue of the change in internal pressure of the bellows. A load from the elastic deformation extends to the auxiliary equipment and this may cause a risk that the auxiliary equipment is damaged.

SUMMARY OF THE INVENTION

[0004] An object of the present invention is to provide a flow path structure in which a load generated when a bellows constituting part of the gas flow path of a vacuum pump is elastically deformed by virtue of the change in the pressure in the bellows, does not extend to auxiliary equipment to which the vacuum pump is connected via the bellows.

[0005] With a view to attaining the object, according to an aspect of the present invention, there is provided a flow path structure for a vacuum pump in which a gas delivering body in a pump chamber is activated based on rotation of a rotating shaft so that gas is delivered through operation of the gas delivering body to thereby provide a sucking operation, the flow path structure comprising a piping mechanism constituting a gas flow path for the gas and connected to a housing of a main body of the vacuum pump in such a manner as to provide a communication with said pump chamber, a bellows constituting at least part of the piping mechanism and a cover incorporating therein the main body of the vacuum pump and adapted to fix the piping mechanism, wherein the bellows is incorporated in the cover, and wherein the piping mechanism is fixed to the cover.

[0006] A load generated in association with the elastic deformation of the bellows in the cover is received and absorbed by the cover. Consequently, the load generated in association with the elastic deformation does not extend to auxiliary equipment of the vacuum pump.

[0007] According to another aspect of the present invention, the bellows is disposed so as to be inclined relative to the rotating shaft.

[0008] The construction in which the bellows is disposed so as to be inclined relative to the rotating shaft, is advantageous in making the overall length of the bellows as long as possible.

[0009] According to a further aspect of the present invention, the piping mechanism is disposed linearly along an external wall surface of the housing of the main body of the vacuum pump.

[0010] The linear piping mechanism is advantageous in making the apparatus compact.

[0011] According to a still further aspect of the present invention, the piping mechanism is made substantially parallel to the rotating shaft.

[0012] Vibrations of the vacuum pump are mainly generated in a direction normal to the rotating shaft. The bellows of the piping mechanism which is substantially parallel to the rotating shaft extends and/or contracts in axial directions of the rotating shaft, and consequently the disposition of the bellows is the most effective to absorb vibrations of the vacuum pump.

[0013] According to a still further aspect of the present invention, a through-hole is formed in the cover, the piping mechanism passes through the through-hole, and a seal means is disposed to be joined to the piping mechanism and the cover, to seal between the interior and

exterior of the cover.

[0014] The through-hole does not constitute a portion which provides communication between the interior and exterior of the cover, whereby the sealing properties within the cover can be secured.

[0015] The present invention may be more fully understood from the description of preferred embodiments of the invention, as set forth below, together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] In the drawings;

Fig. 1 is a side view of a multi-stage Roots pump placed in a cover according to a first embodiment of the present invention,
Fig. 2 is a plan view of the multi-stage Roots pump in the cover shown in Fig. 1,
Fig. 3A is a cross-sectional side view of a main portion of a discharge piping mechanism, and Fig. 3B is a cross-sectional side view of a main portion of a suction piping mechanism,
Fig. 4 is a longitudinally horizontally cross-sectional view of the multi-stage Roots pump,
Fig. 5A is a cross-sectional view taken along the line A-A in Fig. 4, and Fig. 5B is a cross-sectional view taken along the line B-B in Fig. 4,
Fig. 6A is a cross-sectional view taken along the line C-C in Fig. 4, and Fig. 6B is a cross-sectional view taken along the line D-D in Fig. 4,
Figs. 7A, 7B show a second embodiment according to the present invention, in which Fig. 7A is a cross-sectional side view showing a main portion of a discharge piping mechanism, and Fig. 7B is a cross-sectional side view showing a main portion of a suction piping mechanism, and
Figs. 8A, 8B show a third embodiment according to the present invention, in which Fig. 8A is a cross-sectional side view showing a main portion of a discharge piping mechanism, and Fig. 8B is a cross-sectional side view showing a main portion of a suction piping mechanism.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] A first embodiment of the present invention in which the invention is embodied in a Roots pump will be described below with reference to Figs. 1 to 6B.

[0018] As shown in Fig. 4, a front housing 13 is joined to a front end of a rotor housing 12 of a multi-stage Roots pump 11, and a seal body 36 is joined to the front housing 13. A rear housing 14 is joined to a rear end of the rotor housing 12. The rotor housing 12 comprises a cylinder block 15 and a plurality of partitions 16. As shown in Fig. 5B, the cylinder block 15 comprises a pair of block pieces 17, 18, and the partition 16 comprises a pair of wall pieces 161, 162. As shown in Fig. 4, a space between the front housing 13 and the partition 16, spaces between the adjacent partitions 16 and a space between the rear housing 14 and the partitions 16 constitute pump chambers 66, 67, 68, 69, 70, respectively.

[0019] A rotating shaft 19 is rotatably supported on the front housing 13 and the rear housing 14 via radial bearings 21, 37. A rotating shaft 20 is rotatably supported on the front housing 13 and the rear housing 14 via radial bearings 22, 38. Both the rotating shafts 19, 20 are disposed horizontally parallel to each other. The rotating shafts 19, 20 are passed through the partitions 16.

[0020] A plurality of rotors 23, 24, 25, 26, 27 are integrally formed on the rotating shaft 19, and a plurality of rotors 28, 29, 30, 31, 32 are integrally formed on the rotating shaft 20. The rotors 23 to 32 are formed in the same configuration and size when viewed in a direction along axes 191, 201 of the rotating shafts 19, 20. The thicknesses of the rotors 23, 24, 25, 26, 27 are reduced in that order, and the thicknesses of the rotors 28, 29, 30, 31, 32 are reduced in that order. The rotors 23, 28 are accommodated in the pump chamber 66 in a state in which they mesh with each other, the rotors 24, 29 are accommodated in the pump chamber 67 in a state in which they mesh with each other, the rotors 25, 30 are accommodated in the pump chamber 68 in a state in which they mesh with each other, the rotors 26, 31 are accommodated in the pump chamber 69 in a state in which they mesh with each other, and the rotors 27, 32 are accommodated in the pump chamber 70 in a state in which they mesh with each other.

[0021] A gear housing 33 is assembled to the rear housing 14. The rotating shafts 19, 20 pass through the rear housing 14 and protrude into the gear housing 33, and gears 34, 35 are securely fastened to protruding ends of the rotating shafts 19, 20, respectively, in a state in which they mesh with each other. An electric motor M is assembled to the gear housing 33. The driving force of the electric motor M is transmitted to the rotating shaft 19 via an axial joint 10, and the rotating shaft 19 is rotated in a direction indicated by arrows R1 in Figs. 5A, 5B and Figs. 6A, 6B. The rotating shaft 20 obtains the driving force from the electric motor M via the gears 34, 35 and rotates in a direction indicated by arrows R2 in Figs. 5A, 5B and Figs. 6A, 6B, which is an opposite direction to the rotating direction of the rotating shaft 19.

[0022] As shown in Figs. 4 and 5B, a passage 163 is formed in the partition 16. As shown in Fig. 5B, an inlet 164 and an outlet 165 of the passage 163 are formed in the partition 16. The adjacent pump chambers 66, 67, 68, 69, 70 are allowed to communicate with each other via the passages 163.

[0023] As shown in Fig. 5A, an introduction port 171 is formed in the block piece 17 in such a manner as to communicate with the pump chamber 66. As shown in Fig. 6B, a discharge port 181 is formed in the block piece 18 in such a manner as to communicate with the pump chamber 70. Gas introduced into the pump chamber 66

from the introduction port 171 is delivered into the passage 163 from the inlet 164 by virtue of rotation of the rotors 23, 28, and then is delivered out from the outlet 165 into the adjacent pump chamber 67 by way of the passage 163. Thus, similarly, the gas is delivered in the order in which the capacities of the pump chambers are decreased, that is, in the order of the pump chambers 67, 68, 69, and 70. The gas that has been delivered to the pump chamber 70 is then discharged to the outside from the discharge port 181. The rotors 23 to 32 are a gas delivering mechanism for delivering the gas.

[0024] The rotor housing 12, the front housing 13, the rear housing 14 and the gear housing 33 constitute a housing of a main body of the multi-stage Roots pump. As shown in Figs. 1 and 2, the main body of the multi-stage Roots pump is incorporated in a cover 47, which is securely fastened to fixing portions of a place where the apparatus is installed.

[0025] As shown in Fig. 6B, a connecting flange 39 is connected to the discharge port 181. As shown in Fig. 3A, a muffler 40 is connected to the connecting flange 39, and a cylindrical guide pipe 41 is connected to the muffler 40. A discharge pipe 42 is connected to the guide pipe 41. A through hole 471 is formed in an upper portion of a wall 473 of the cover 47 in front of the front housing 13, and the discharge pipe 42 is passed through the through hole 471. The discharge pipe 42 passes through the cover 47 and then connects to an exhaust gas processing device, not shown. A bellows 421 is incorporated in series with the discharge pipe 42. The bellows 421 is spaced apart from the housing constituting the main body of the multi-stage Roots pump 11. A mounting flange 422 is formed around an outer circumference of the discharge pipe 42. The mounting flange 422 is fixed to the cover 47 by tightening screws 57, and the bellows 421 is incorporated in the cover 47.

[0026] The connecting flange 39, the muffler 40, the guide pipe 41 and the discharge pipe 42 are disposed linearly along an external wall surface of the rotor housing 12 in such a manner as to become substantially parallel to the rotating shafts 19, 20. The connecting flange 39, the muffler 40, the guide pipe 41 and the discharge pipe 42, which are disposed linearly, constitute a discharge piping mechanism 64 for delivering exhaust gas, that is discharged from the multi-stage Roots pump 11, to the exhaust gas processing device. The discharge piping mechanism 64 is connected to the rotor housing 12 constituting the housing of the main body of the multi-stage Roots pump 11 in such a manner as to communicate with the pump chamber 70.

[0027] A valve body 43 and a return spring 44 are accommodated in the guide pipe 41. A tapered valve hole 411 is formed in the guide pipe 41, and the valve body 43 is adapted to open/close the valve hole 411. The guide pipe 41, the valve body 43 and the return spring 44 constitutes a reverse flow preventing means. Exhaust gas discharged from the pump chamber 70 having the smallest capacity of all the pump chambers to the connecting flange 39, by way of the discharge port 181, reaches the valve hole 411 by way of the muffler 40. In a case where a load, applied to a closing end wall 45 of the valve body 43 by the pressure inside the muffler 40, exceeds a load applied to the closing end wall 45 by the pressure inside the guide pipe 41 and the spring force of the return spring 44, the valve body 43 opens the valve hole 411. Exhaust gases that have passed through the valve hole 411, flow to the discharge pipe 42 side through the circumference of a circumferential wall 46 of the valve body 43 and a communication hole 461.

[0028] As shown in Fig. 5A, a connecting flange 58 is connected to an introduction port 171. As shown in Fig. 3B, a suction pipe 59 is connected to the connecting flange 58. A through hole 472 is provided in a lower portion of the wall 473 of the cover 47, and the suction pipe 59 is passed through the through hole 472. The suction pipe 59 passes through the cover 47 to be connected to a target suction device, not shown. A bellows 591 is incorporated in the suction pipe 59 in series. The bellows 591 is spaced apart from the housing constituting the main body of the multi-stage Roots pump 11. A mounting flange 592 is formed around an outer circumference of the suction pipe 59. The mounting flange 592 is fixed to the cover 47 by tightening screws 60, the bellows 591 is incorporated in the cover 47.

[0029] The connecting flange 58 and the suction pipe 59 are disposed linearly along the external wall surface of the rotor housing 12 in such a manner as to become substantially parallel to the rotating shafts 19, 20. The connecting flange 58 and the suction pipe 59 constitute a suction piping mechanism 65 for delivering exhaust gases sucked from the target suction device to the multi-stage Roots pump 11. The suction piping mechanism 65 is connected to the rotor housing 12 constituting the housing of the main body of the multi-stage Roots pump 11 in such a manner as to communicate with the pump chamber 66.

[0030] As shown in Figs. 1 and 2, the multi-stage Roots pump 11 is accommodated in the cover 47. As shown in Fig. 1, legs 111 are formed on a lower surface of the multi-stage Roots pump 11. The legs 111 are connected to a bottom wall of the cover 47 via rubber cushions 61, respectively.

[0031] As shown in Fig. 2, mounted in the cover 47 are a controller 48 and an inverter 49 for controlling the electric motor M. A cooler 50 is placed on a lower surface of the rear housing 14. A cooler 51 is placed on an upper surface of the controller 48, and a cooler 52 is placed on an upper surface of the inverter 49. Cooling fluid is delivered to a main supply pipe 53 from a cooling fluid supply source, not shown. The cooling fluid delivered to the main supply pipe 53 passes through the cooler 51 and the cooler 52 in that order. In a case where an electromagnetic three-way valve 55 is in a de-excited state, the cooling fluid that has passed through the cooler 52 is refluxed to the cooling fluid supply source by

way of the main supply pipe 53. On the contrary, in a case where the electromagnetic three-way valve 55 is in an excited state, the cooling fluid that has passed through the cooler 51 flows to the cooler 50 side by way of a sub-supply pipe 54. A temperature detector 56 attached to a surface of the rear housing 14 detects the temperature of the surface of the rear housing 14. The controller 48 control excites and/or de-excites the electromagnetic three-way valve 55 based on temperature detection information obtained from the temperature detector 56. Namely, the controller 48 controls the exciting and/or de-exciting of the magnetic three-way valve 55 so that the temperature on the surface of the rear housing 14 reaches a predetermined temperature.

[0032] The following advantages are obtained from the first embodiment.

(1) The vibrations of the main body of the multi-stage Roots pump 11 generated in association with the rotation of the rotors 23 to 32 are transmitted through the suction piping mechanism 65 and the discharge piping mechanism 64. The vibrations of the main body of the multi-stage Roots pump 11, which are transmitted through the suction piping mechanism 65, are absorbed by the bellows 591. The vibrations of the main body of the multi-stage Roots pump 11, which are transmitted through the discharge piping mechanism 64, are absorbed by the bellows 421. The pressure in the suction piping mechanism 65 varies from atmospheric pressure to a negative pressure which is close to zero. The pressure in the discharge piping mechanism 64 from the main body of the multi-stage Roots pump 11 to the valve body 43 changes from a positive pressure, which is equal to or higher than the atmospheric pressure, to a negative pressure which is close to zero. In addition, the pressure in the discharge piping mechanism 64 downstream of the valve body 43 varies from a positive pressure, which is higher than the atmospheric pressure, to atmospheric pressure. The atmospheric atmosphere is present in the pump chambers 66 to 70 before the multi-stage Roots pump starts to operate, and the positive pressure, which is equal to or higher than the atmospheric pressure, is generated when the atmospheric atmosphere is compressed immediately after the multi-stage Roots pump has started to operate. The bellows 421, 591 are elastically deformed to extend or contract by virtue of the pressure variations. The bellows 421, 591 are incorporated in the cover 47, and the loads generated in association with the elastic deformations of the bellows 421, 591 in the cover 47 are received and absorbed by the cover 47. Consequently, the loads generated in association with the elastic deformations of the bellows 421, 591 do not extend to the auxiliary equipment.

(2) The discharge piping mechanism 64 and the suction piping mechanism 65 are disposed linearly along the external wall surface of the rotor housing 12 constituting the housing of the main body of the multi-stage Roots pump 11. The construction, in which the discharge piping mechanism 64 and the suction piping mechanism 65 are disposed linearly along the external wall surface of the rotor housing 12, can ensure that an exclusive space for peripheral attachments to the main body of the multi-stage Roots pump 11 is small. Consequently, a compact cover 47 can be adopted, and this makes the multi-stage Roots pump 11 itself, including the cover 47, compact.

(3) The vibrations of the multi-stage Roots pump 11 are mainly generated in the direction normal to the rotating shafts 19, 20. The bellows 421 of the discharge piping mechanism 64, which is substantially parallel to the rotating shafts 19, 20, and the bellows 591 of the suction piping mechanism 65, which are substantially parallel to the rotating shafts 19, 20, extend and/or contract in the direction of the axes 191, 201 of the rotating shafts 19, 20. Vibrations in directions normal to the directions in which the bellows 421, 591 extend and/or contract are easier to absorb than vibrations in the directions in which the bellows 421, 591 extend and/or contract. Consequently, the construction, in which the bellows 421, 591 are disposed substantially parallel to the rotating shafts 19, 20, is most effective to absorb vibrations of the multi-stage Roots pump 11.

[0033] Next, a second embodiment shown in Figs. 7A, 7B will be described. The same reference numerals will be imparted to constituent components similar to those described in the first embodiment.

[0034] A seal member 62 is interposed between a mounting flange 422 and a wall 473, and a seal member 63 is interposed between a mounting flange 592 and the wall 473. The seal member 62.is joined to the mounting flange 422 and the wall 473, and constitutes a seal means for cutting off communications between the interior and exterior of the cover 47 through a through hole 471. The seal member 63 is joined to the mounting flange 592 and the wall 473, and constitutes a seal means for cutting off communications between the interior and exterior of the cover 47 through a through hole 472. There is no gap in the cover 47 and the interior of the cover 47 is completely sealed by the cover 47. Consequently, even if there should occur a leakage of exhaust gases from the main body of the multi-stage Roots pump 11, the suction piping mechanism 65 or the discharge piping mechanism 64, the gas that has so leaked can be sealed in the cover 47.

[0035] Next, a third embodiment illustrated in Figs. 8A, 8B will be described. The same reference numerals will be imparted to constituent components similar to those described in the first embodiment.

[0036] A bellows 421 which is part of a discharge pipe

42A constituting a discharge piping mechanism 64A is disposed in such a manner as to be inclined relative to rotating shafts 191, 201 (not shown). A bellows 591 which is part of a suction pipe 59A constituting a suction piping mechanism 65A is disposed in such a manner as to be inclined relative to rotating shafts 191, 201 (not shown). The construction in which the bellows 421, 591 are disposed in such a manner as to be inclined relative to the rotating shafts 191, 201 is advantageous in making the overall lengths of the bellows 421, 591 as long as possible without extending the length of the main body of the multi-stage Roots pump in the axial direction thereof. The more the bellows 421, 591 extend, the more advantageous it is in absorbing vibrations of the main body of the multi-stage Roots pump.

[0037] The following embodiments may be provided according to the present invention.

(1) The bellows are directly joined to the cover.

(2) The muffler 40 may be made to function as a bellows on the discharge piping mechanism side. In this case, the muffler 40 and the guide pipe 41 need to be spaced apart from the housing of the main body of the multi-stage Roots pump.

(3) The piping mechanism for forming the gas flow path inside the cover 47 may be connected to the internal surface of the cover 47 in such a manner as to communicate with the through hole in the cover 47, and the piping mechanism for forming the gas flow path outside the cover 47 is connected to the external surface of the cover in such a manner as to communicate with the through hole in the cover 47.

(4) The present invention may be applied to vacuum pumps other than Roots pumps.

[0038] As has been described heretofore, according to the present invention, the bellows constituting at least part of the piping mechanisms are incorporated in the cover, and the piping mechanisms are connected to the cover. Thus, the present invention provides a superior advantage that the loads generated when the bellows constituting part of the gas flow path of the vacuum pump are elastically deformed, by virtue of the change in internal pressures, can be prevented from extending to the auxiliary equipment.

Claims

1. A flow path structure for a vacuum pump in which a gas delivering mechanism in a pump chamber is activated based on rotation of a rotating shaft so that gas is delivered through operation of said gas delivering body to thereby provide a sucking operation, said flow path structure comprising a piping mechanism constituting a gas flow path for said gas and connected to a housing of a main body of said vacuum pump in such a manner to communicate with said pump chamber, a bellows constituting at least part of said piping mechanism and a cover incorporating therein said main body of said vacuum pump and fixing said piping mechanism, wherein said bellows is incorporated in said cover, and wherein said piping mechanism is fixed to said cover.

2. A flow path structure for a vacuum pump, as set forth in Claim 1, wherein said bellows is disposed in such a manner as to be inclined relative to said rotating shaft.

3. A flow path structure for a vacuum pump, as set forth in Claim 1, wherein said piping mechanism is disposed linearly along an external wall surface of said housing of said main body of said vacuum pump.

4. A flow path structure for a vacuum pump, as set forth in Claim 1, wherein said piping mechanism is made substantially parallel to said rotating shaft.

5. A flow path structure for a vacuum pump, as set forth in any of Claims 1 to 4, wherein a through hole is formed in said cover, and said piping mechanism passes through said through-hole, and wherein a seal mechanism is disposed to be joined to said piping mechanism and said cover, to seal between the interior and exterior of said cover.

6. A flow path structure for a vacuum pump, as set forth in any of Claims 1 to 5, wherein said piping mechanism is a discharge piping mechanism constituting a gas flow path on a discharge side.

7. A flow path structure for a vacuum pump, as set forth in any of Claims 1 to 5, wherein said piping mechanism is a suction piping mechanism constituting a gas flow path on a suction side.

8. A flow path structure for a vacuum pump as set forth in any of Claims 1 to 7, wherein said vacuum pump is a vacuum pump in which a plurality of said rotating shafts are disposed in parallel to each other, in which rotors as said gas delivering mechanism are disposed on each of said plurality of said rotating shafts, in which said rotors on said rotating shafts which are adjacent to each other are made to mesh with each other, and in which a plurality of pump chambers or a single pump chamber is provided in which said rotors which are in a state in which said rotors mesh with each other are accommodated as a set.

Fig.1

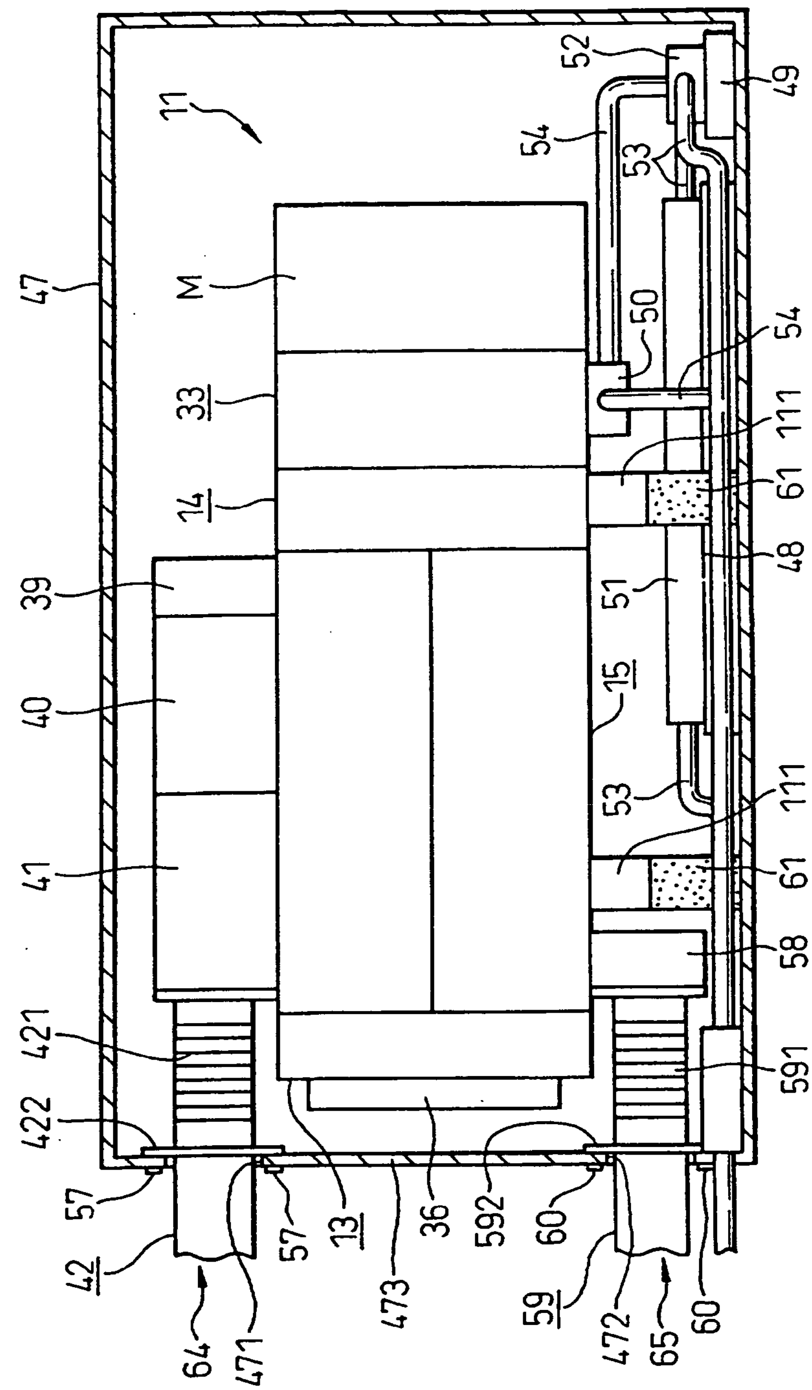
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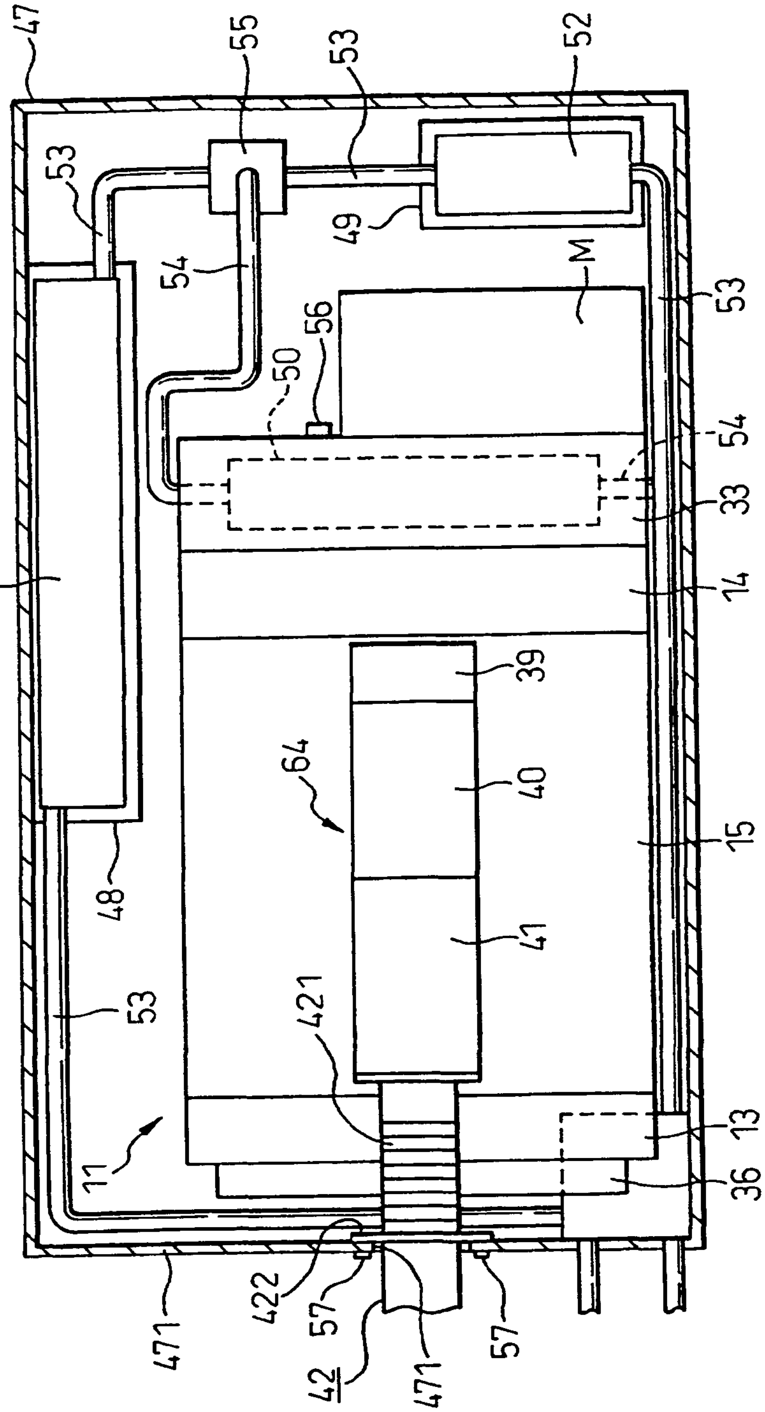
Fig.2



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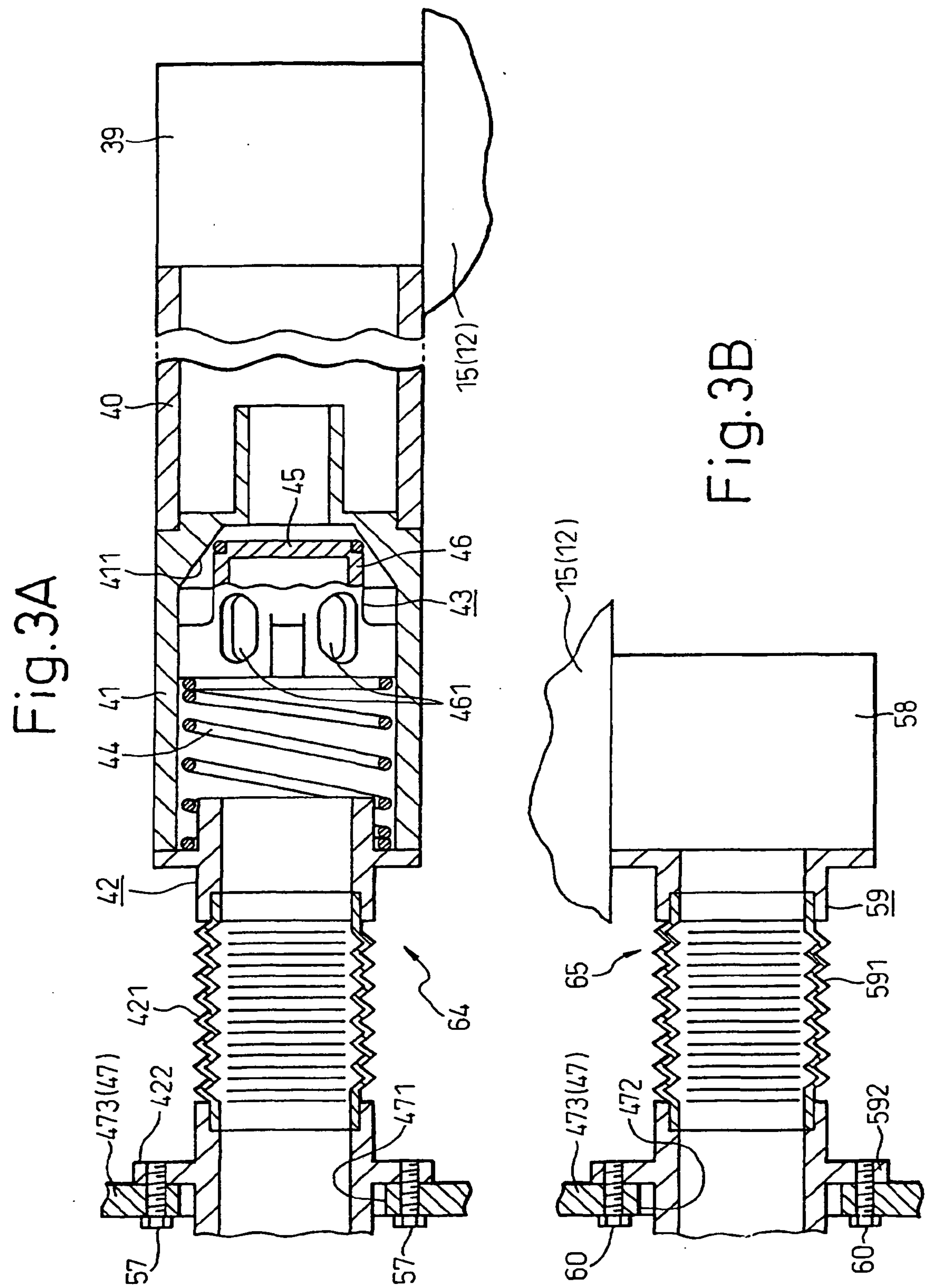
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Fig.3A

Fig.3B

Fig.4

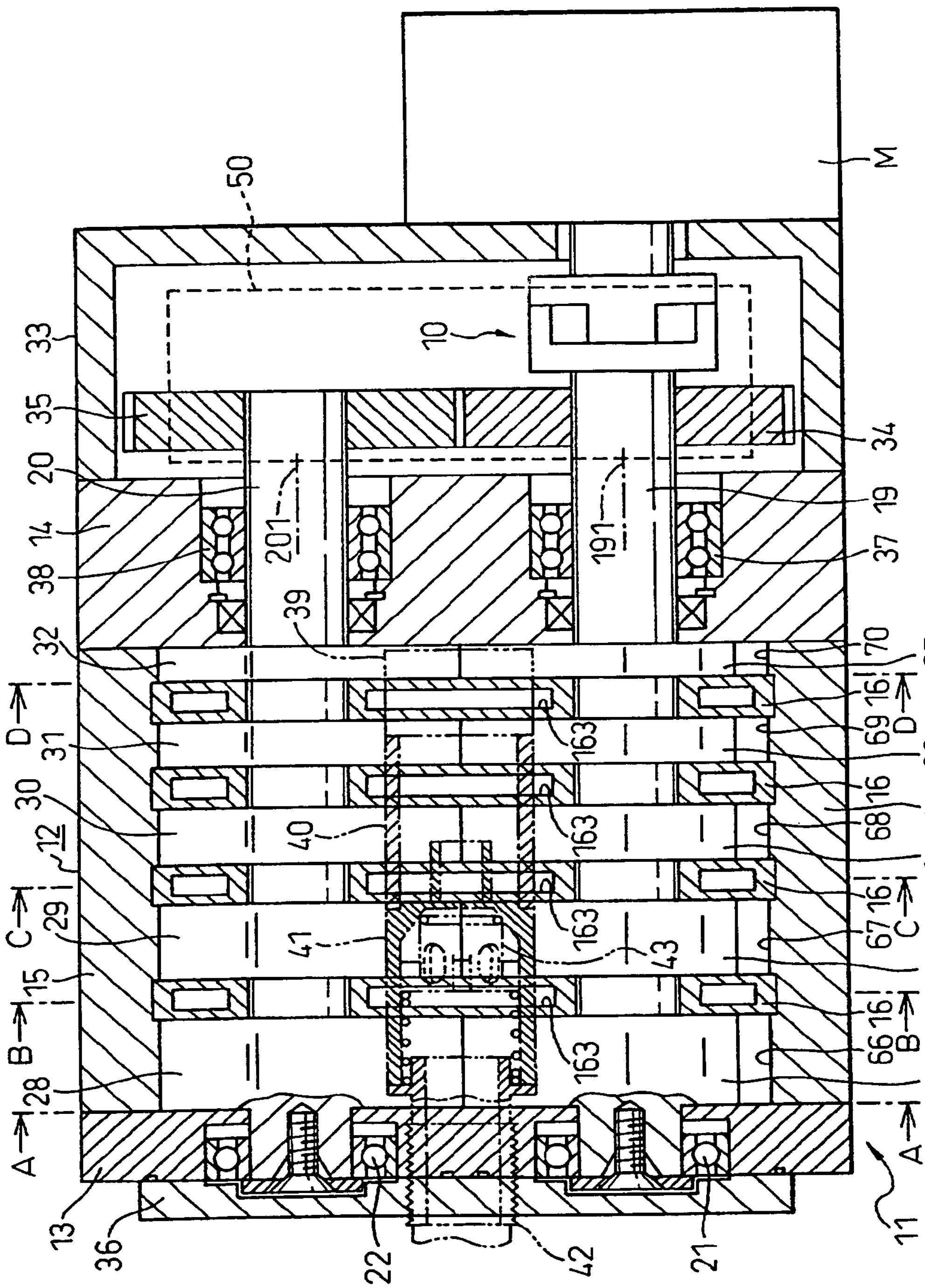

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Fig.5A

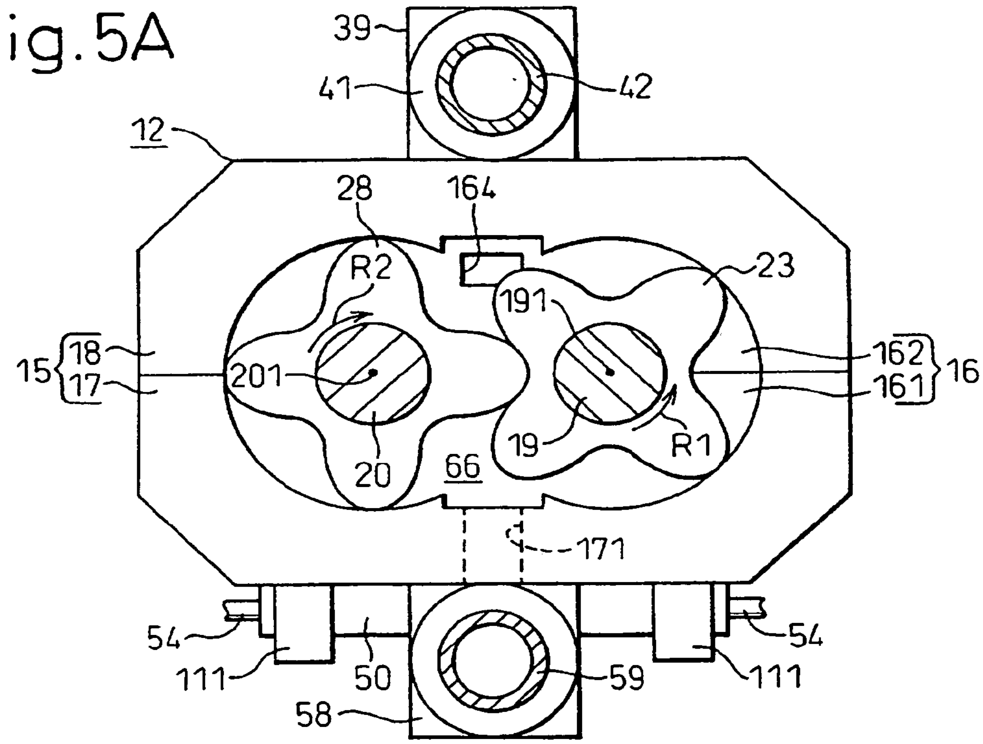
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Fig.5B

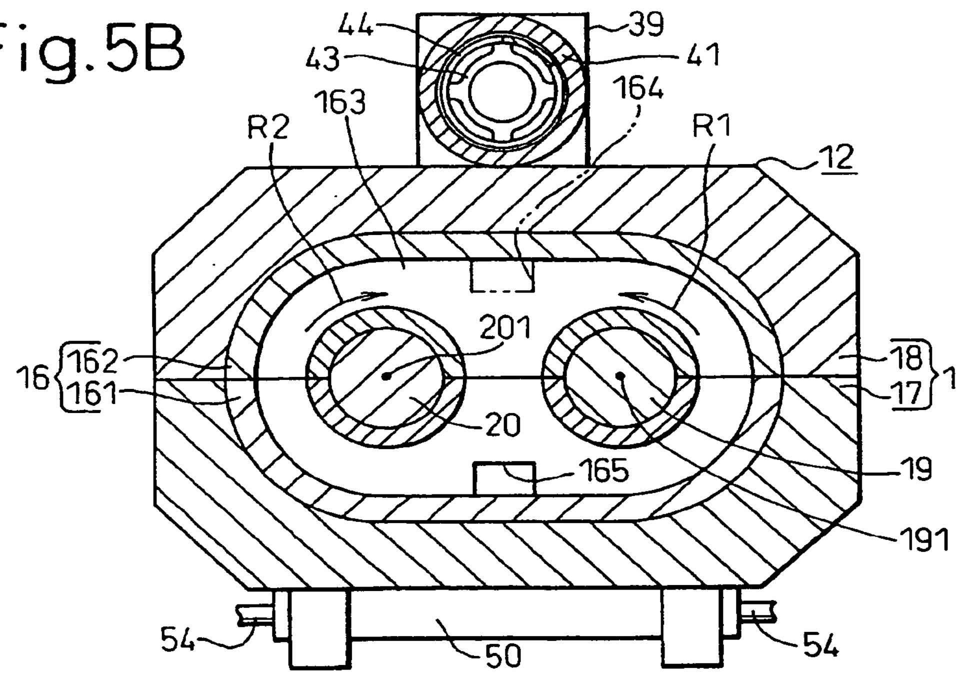
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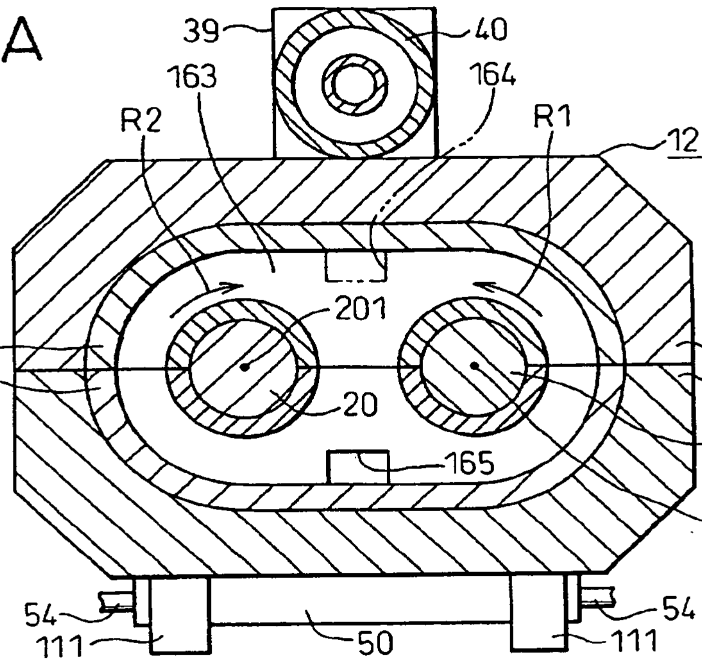
Fig.6A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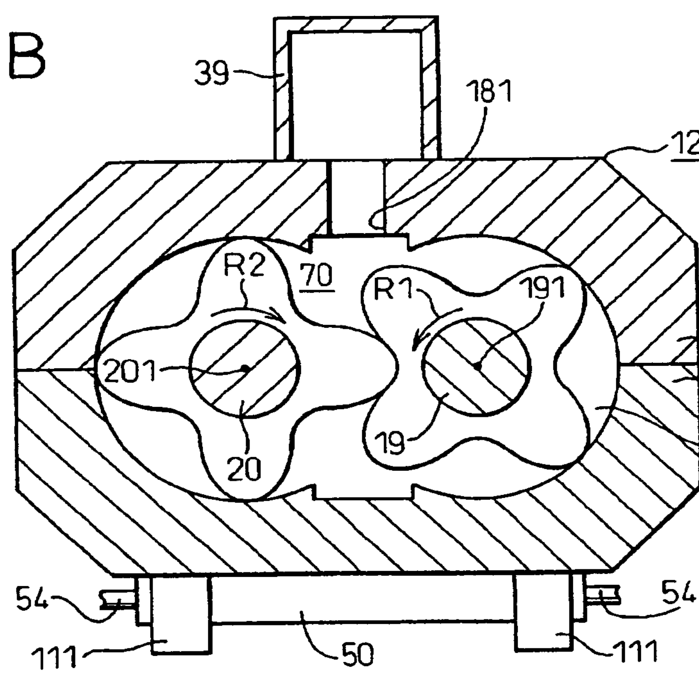
54
54
111
50
111

Fig.6B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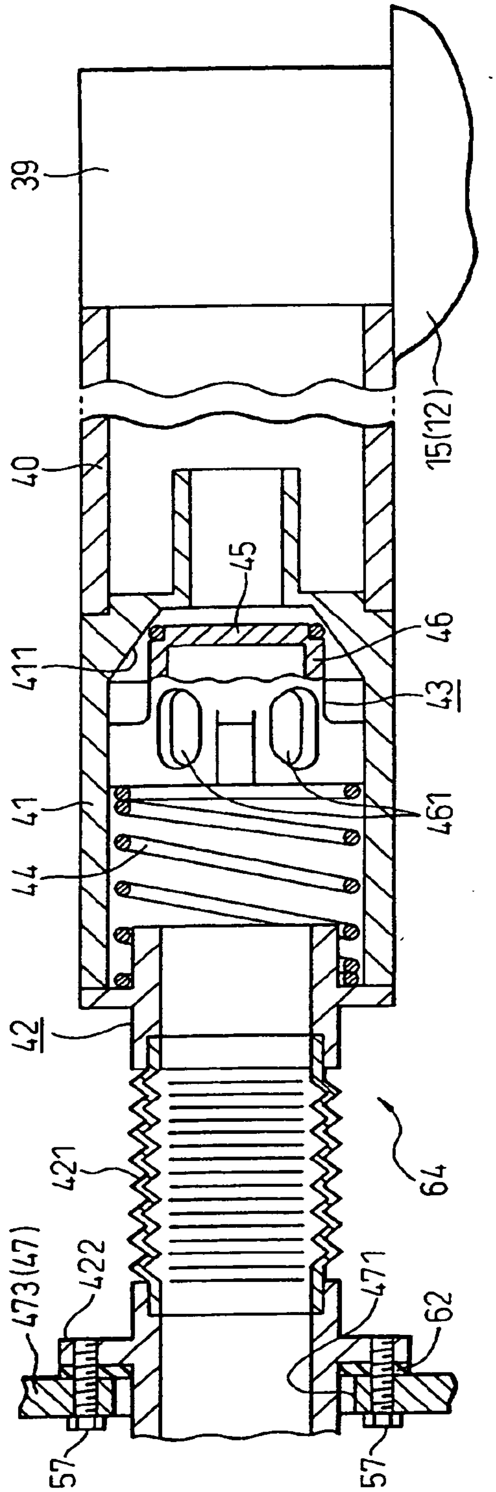
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473(47)
422
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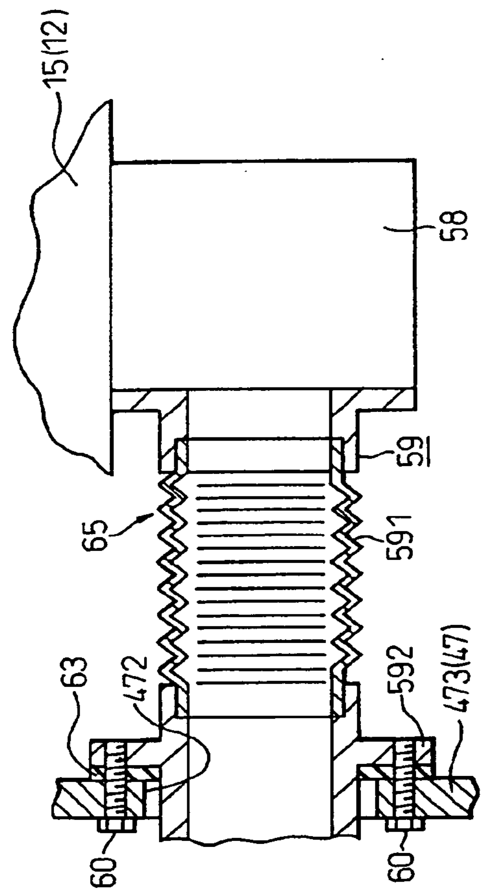
57

Fig. 7A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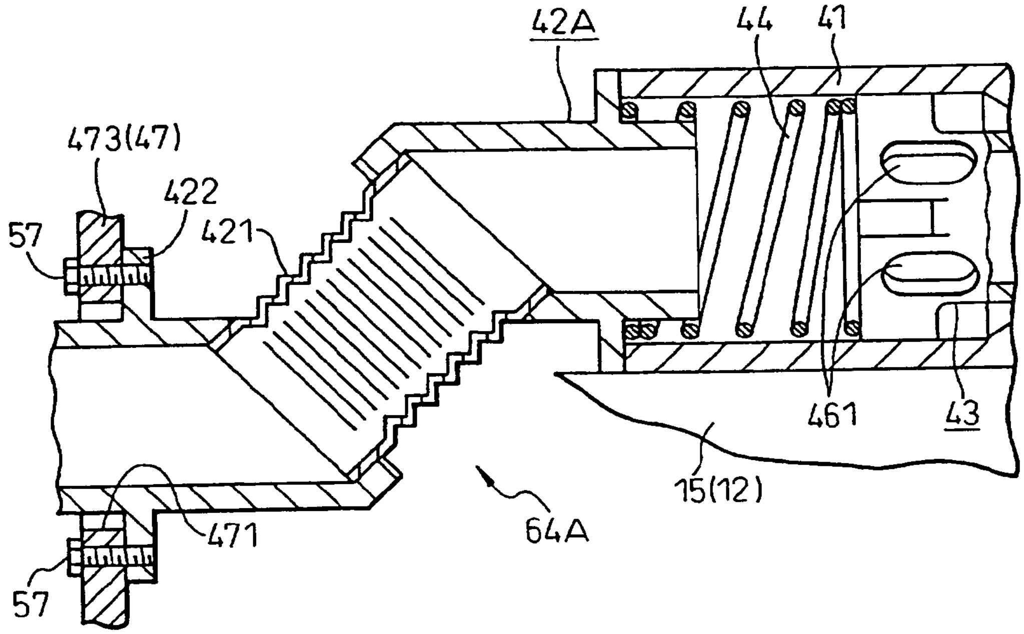
592
473(47)
60
60

Fig. 7B

Fig.8A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15(12)
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64A
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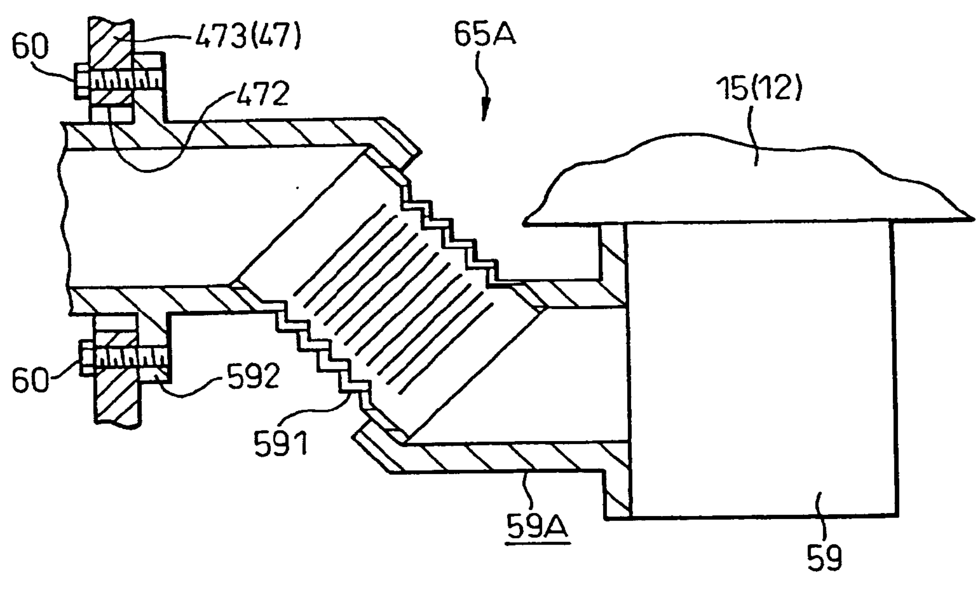
Fig.8B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(19) Europäisches Patentamt
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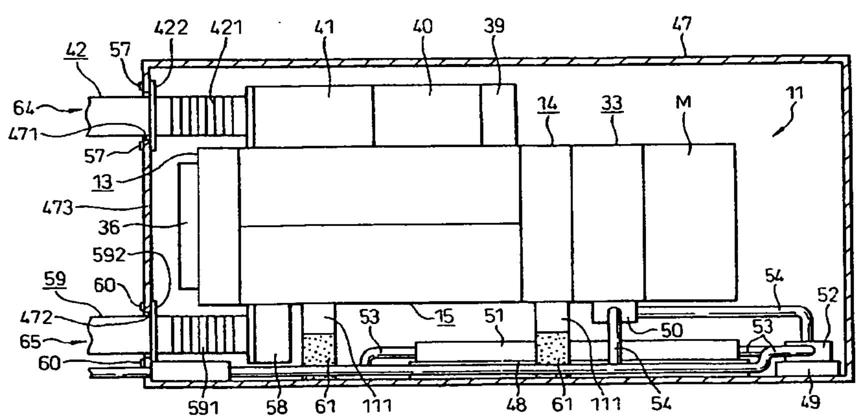
(54) Vacuum pump

(57) A main body of a multi-stage Roots pump 11 is incorporated in a cover 47. A connecting flange 39, a muffler 40, a guide pipe 41 and a discharge pipe 42 constitute a discharge piping mechanism 64. The discharge pipe 42 incorporates a bellows 421. A connecting flange 58 and a suction pipe 59 constitute a suction piping mechanism 65. The suction pipe 59 incorporates a bellows 591. The bellows 421, 591 are incorporated in the cover 47.

Thus, loads generated when the bellows constituting part of the gas flow path of a vacuum pump are elastically deformed, by virtue of changes in internal pressures, are prevented from extending to auxiliary equipment.

Fig.1



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Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	3 December 2002	Dimitroulas, P

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